

Assessment of Recent Aircraft Lightning Accidents

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Presentation Topics

- Review recent accidents
 - Aerospatiale AS-332L 1995
 - Fokker F28-100 1998
 - Schleicher ASK-21 1999
- Related design issues
- Related certification issues

Photo from UK AAIB report 2/97



Aerospatiale AS-332L January 1995

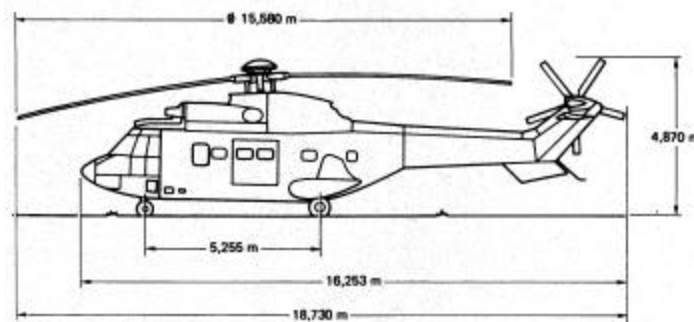
Aerospatiale AS-332L Super Puma

- Accident occurred January 19, 1995
- Struck by lightning over North Sea, approximately 120 nm from Aberdeen Scotland
- Helicopter ditched, and passengers and crew were rescued
- Report by UK Air Accidents Investigation Branch, formal report 2/97

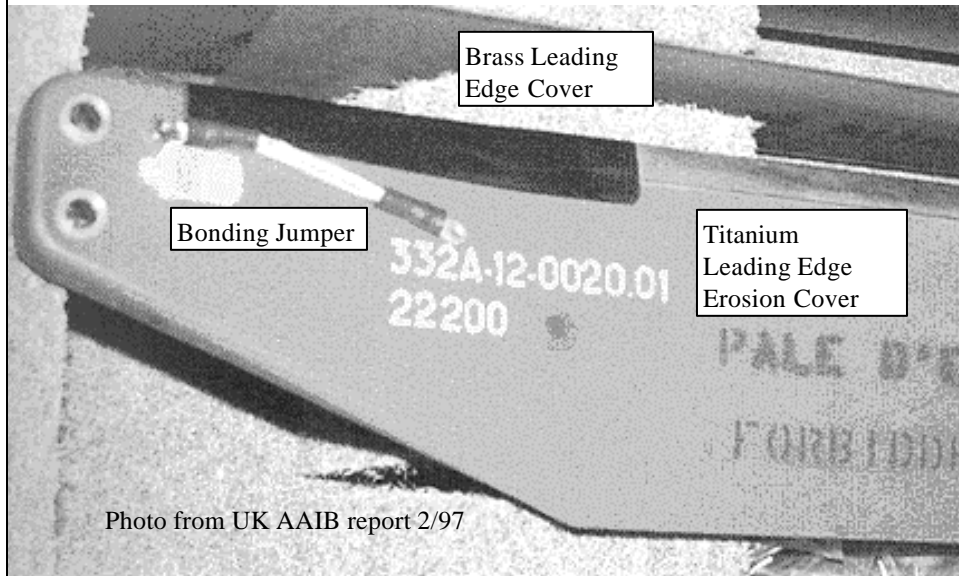
Super Puma Accident Details

- Lightning attached to tail rotor blades and main rotor blades
- Significant damage occurred on one tail rotor blade
- Blade imbalance caused bolts holding tail rotor gearbox to fail
- Tail rotor gearbox separated from helicopter

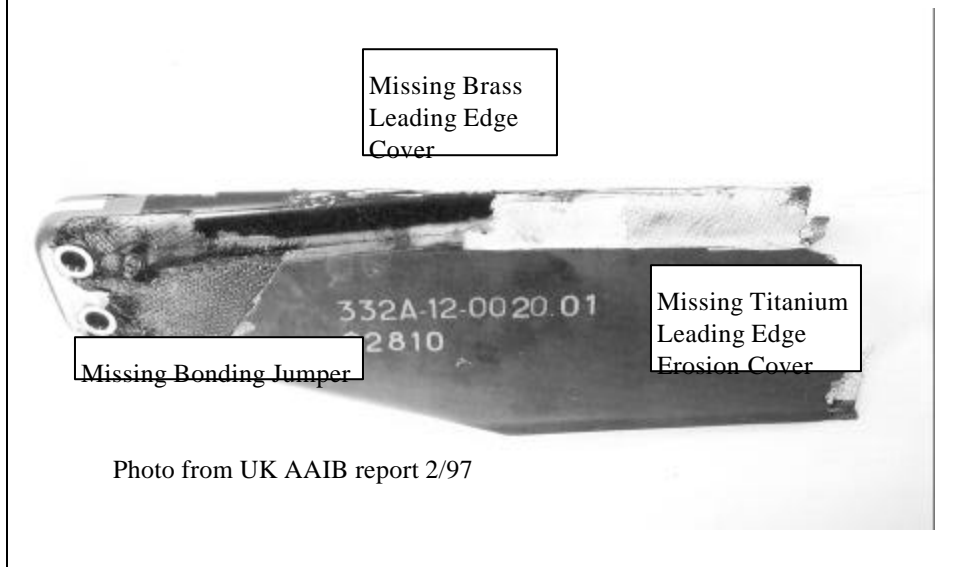
Aerospatiale AS-332L



Undamaged Tail Rotor Blade



Damaged Tail Rotor Blade



Why Did It Happen?

- Damage to tail rotor blade caused unbalance and vibration
- Bolts holding the tail rotor gearbox to tail boom failed, so gearbox separated from the helicopter
- Analysis and test showed that loss of titanium leading edge could cause vibration to failure

Lightning Protection Issues

- Original AS-332 lightning protection was not tested to today's standard
 - Original lightning protection was qualified to much lower action integral
- Tests using today's standard caused tail rotor blade damage that could result in loss of titanium leading edge
- AD was adopted to require lightning protection improvements

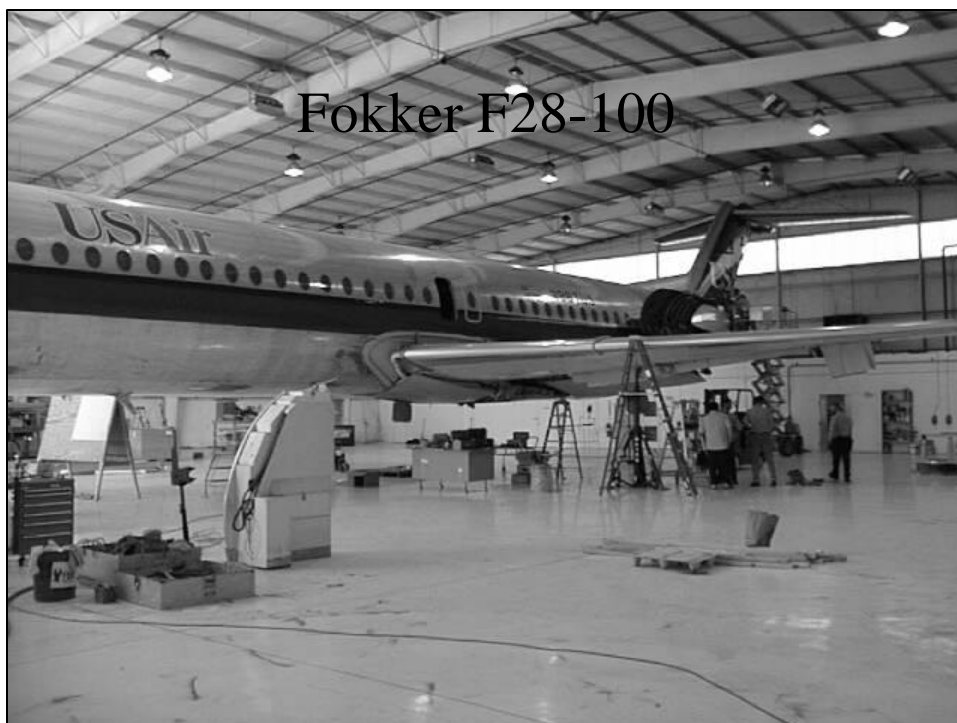
Certification Issues

- UK CAA is considering stricter lightning protection standards for helicopters operating in North Sea
- UK CAA has proposed increasing the lightning action integral from $2 \times 10^6 \text{ A}^2\text{-s}$ to $7 \times 10^6 \text{ A}^2\text{-s}$



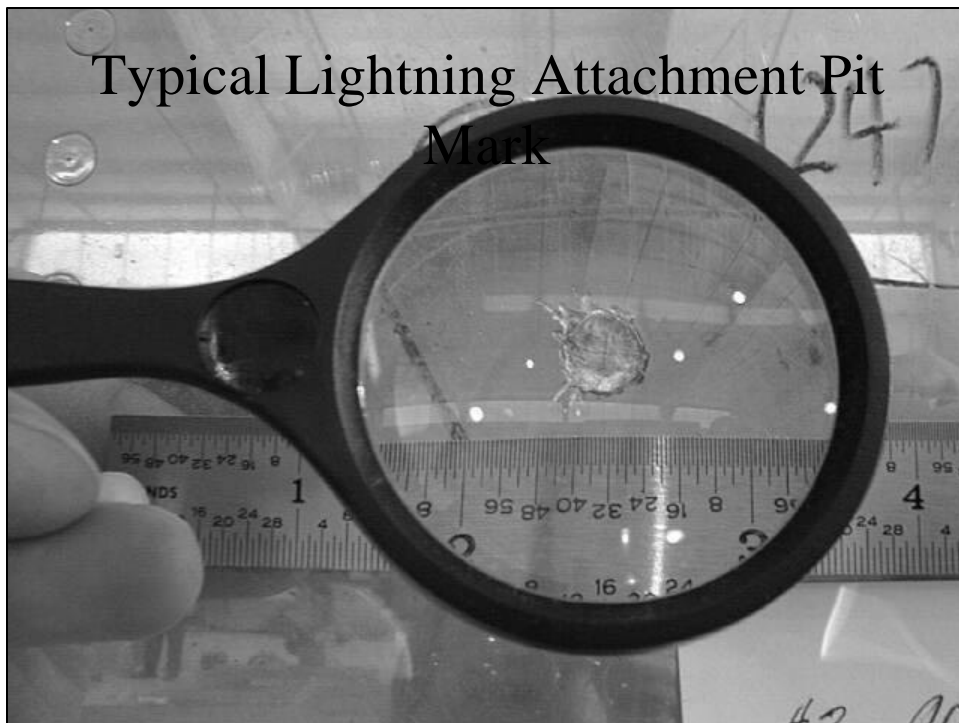
Fokker F28-100

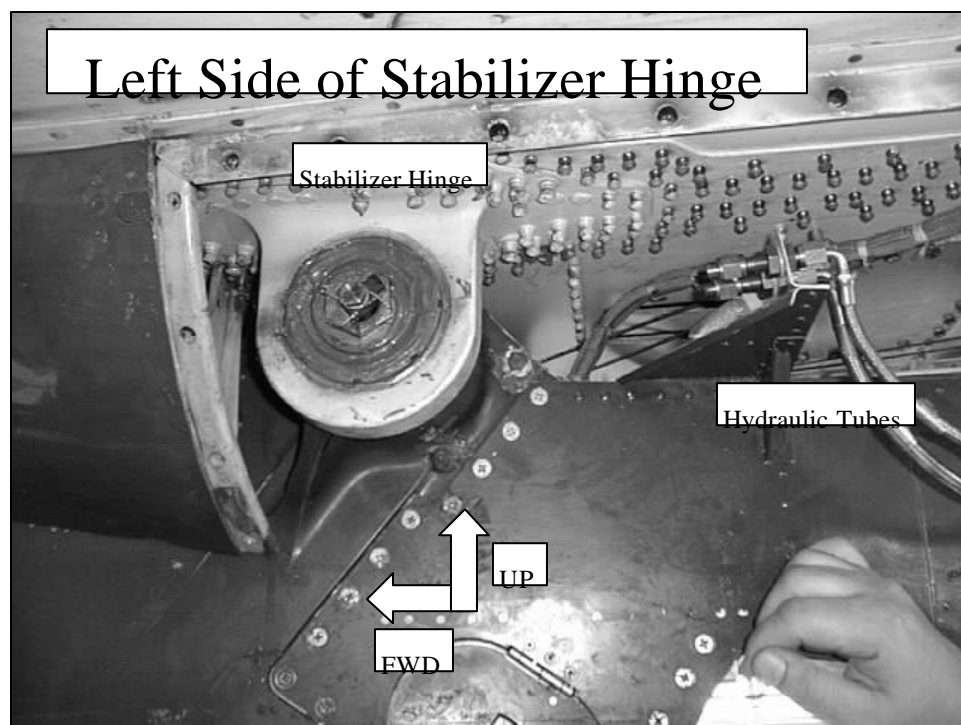
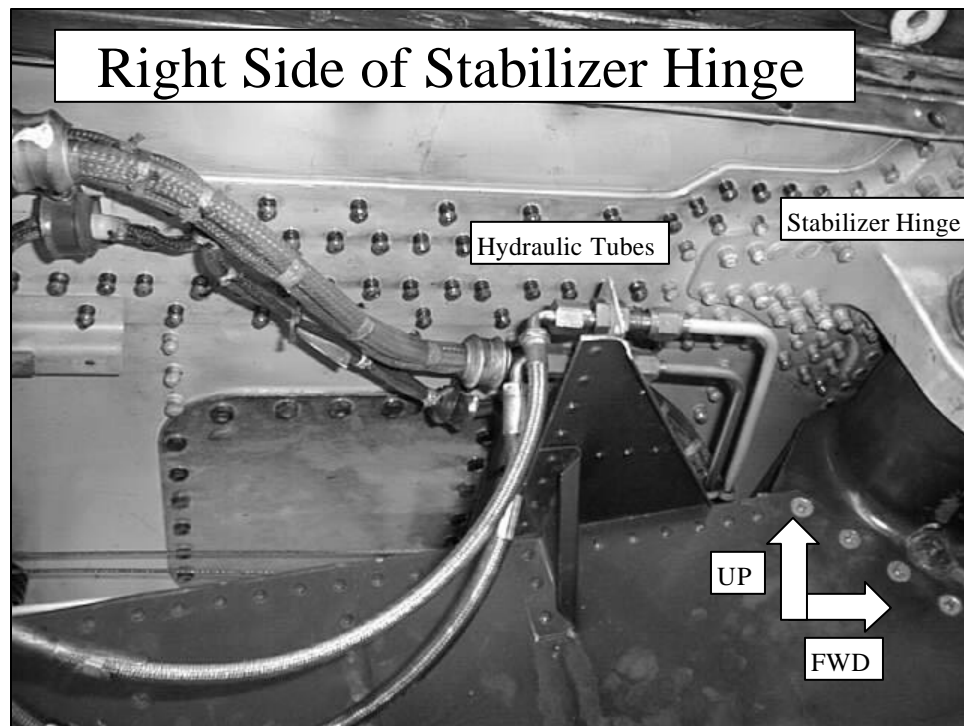
- Accident occurred February 26, 1998
- Struck by lightning on approach to Birmingham, AL
- Airplane lost hydraulic power and ran off runway on landing
- Passengers and crew evacuated without injury
- Investigated by US NTSB- ID no. MIA98FA089



Fokker Accident Details

- Lightning attached along lower right side of fuselage and right horizontal stabilizer tip
- Arcing to hydraulic tubes in the horizontal stabilizer hinge area burned holes in two tubes - one from each system
- Loss of both hydraulic systems, and an unrelated brake antiskid failure caused loss of directional control on landing





Why Did It Happen?

- Single small-gauge bonding strap carried significant lightning current
- Lightning current fused the bonding strap and arced to adjacent hydraulic tube
- Current on hydraulic tube then arced to adjacent hydraulic tube for second hydraulic system

Lightning Protection Issues

- Bonding strap was not sized to carry high lightning currents
- Stabilizer hinge and jackscrew cannot be relied on for lightning current path
- Lightning protection must consider the conducted current paths, not just the lightning attachment locations

Schleicher ASK-21 April 1999



Photo from UK AAIB Bulletin No. 12/99

Wreckage of GBP

Cockpit and tail structures were relatively undamaged until impact with the ground

Figure 4

Schleicher ASK-21 Glider

- Accident occurred April 17, 1999
- Struck by lightning while flying near a cloud line
- Glider broke apart in flight
- Instructor and student pilot parachuted safely
- Investigated by UK Air Accidents Investigation Branch, Bulletin No. 12/99

Schleicher ASK-21 Glider



ASK 21 Two Seat Glider

Figure 1

Manufactured in Germany by A Schleicher. Wing span 17m Max AUW = 1320 lbs

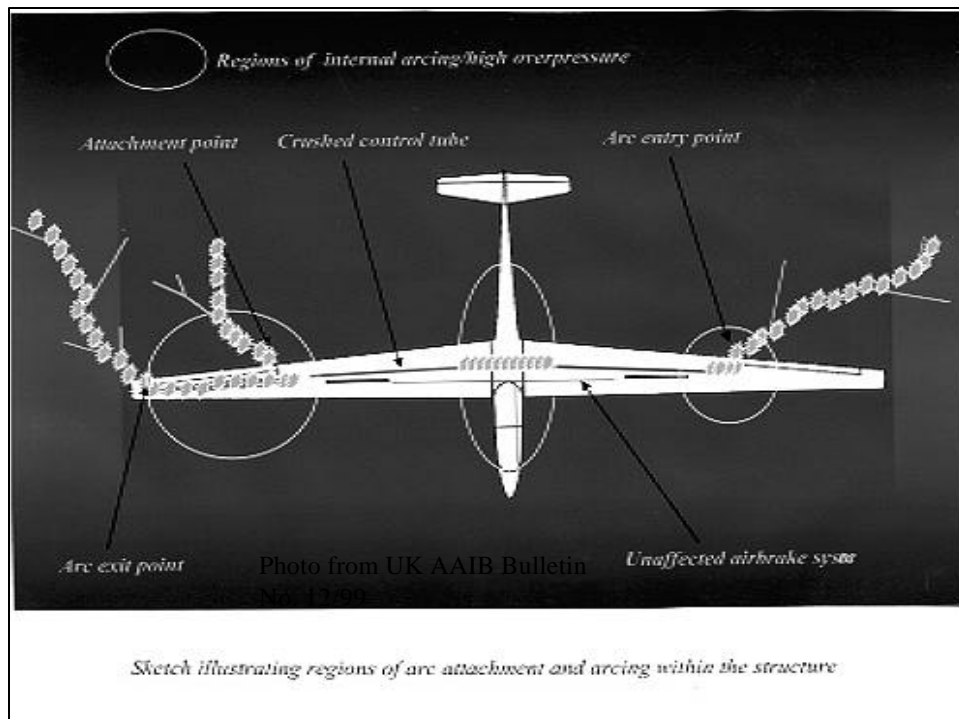
Photo from UK AAIB Bulletin No. 12/99

Schleicher Accident Details

- Lightning attached to both wings
- Explosive arcing in wing and fuselage caused structural failure of wing and fuselage
- Significant lightning arc welding on control rod brackets
- Significant magnetic deformation of control rod tubes

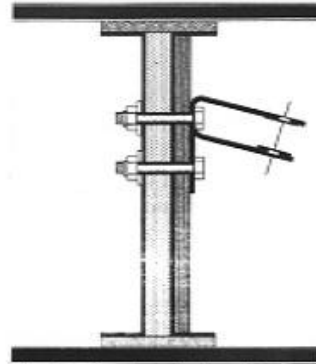
Why Did It Happen?

- Schleicher ASK-21 has no inherent or designed lightning protection
- In general, gliders are not required to have lightning protection
- Lightweight fiberglass and foam structure is not tolerant of explosive arcs within the structure





*Right aileron bellcrank mounting bracket
showing melted end and heat effects*



*Sketch of bracket attachment to spar
Two upper bolts, one lower*



Lower Bolt Failure



*Details of centre push rod from right wing
Rod is normally a tube of 16mm diameter, 1mm wall thickness*



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Photo from UK AAIB Bulletin No. 12/99

Figure 8

Lightning Protection Issues

- Aircraft do not have to be in clouds to be struck by lightning
- Lightning arcs and currents conducted in confined spaces generate significant pressure
- Lightning current can develop strong magnetic forces and subsequent deformation of metal parts

Wrap-Up

- Several lightning-related accidents in the past 6 years
- Design details have been a strong contributor to accidents
- Changes to lightning protection standards are being considered, especially for helicopters in North Sea

QUESTIONS OR COMMENTS

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LUNCH....BREAK....!!!.

